Mx8000

Physics File for Version 2.51 / 2.5 / 2.64

4550 199 93011
Revision B

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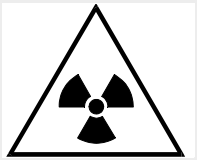
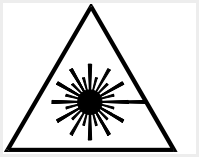
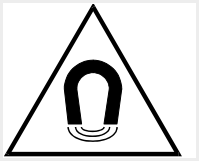
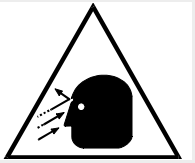
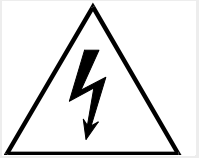
Symbol Descriptions

	Attention symbol		Radiation warning symbol
	Laser warning symbol		Biohazard warning symbol
	Magnetism warning symbol		Projectile warning symbol
	Electrical warning symbol		Do not touch

Revision History

ECO #	Revision	Date	Comments
E13030007	0	May 2003	New Release
E13030011	A	August 2003	Update
E13040007	B	August 2004	Update Table 6

This document was prepared by the CT PMG Haifa Service Innovation Department.
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Safety Information

To the User of This Manual

The user of this manual is directed to read and carefully review the instructions, warnings and cautions contained herein prior to beginning installation or service activities. While you may have previously installed or serviced equipment similar to that described in this manual, changes in design, manufacture or procedure may have occurred which significantly affect the present installation or service.

Installation and Environment

Except for installations requiring certification by the manufacturer per federal standards, see that a radiation protection survey is made by a qualified expert in accordance with NCRP 102, section 7, as revised or replaced in the future. Perform a survey after every change in equipment, workload, or operating conditions which might significantly increase the probability of persons receiving more than the maximum permissible dose equivalent.

Diagnostic Imaging Systems - Mechanical-electrical Warning

All of the moveable assemblies and parts of this equipment should be operated with care and routinely inspected in accordance with the manufacturer's recommendations contained in the equipment manuals.
Only properly trained and qualified personnel should be permitted access to any internal parts. Live electrical terminals are deadly; be sure line disconnects are opened and other appropriate precautions are taken before opening access doors, removing enclosure panels, or attaching accessories.
Do not under any circumstances, remove the flexible high tension cables from the x-ray tube housing or high tension generator and/or the access covers from the generator until the main and auxiliary power supplies have been disconnected. Failure to comply with the above may result in serious or fatal bodily injuries to the operator or those in the area.

Electrical-grounding Instructions

The equipment must be grounded to an earth ground by a separate conductor. The neutral side of the line is not to be considered the earth ground. On equipment provided with a line cord, the equipment must be connected to properly grounded, three-pin receptacle. Do not use a three-to-two pin adapter.

Diagnostic Imaging Systems - Radiation Warning

X-ray and Gamma-rays are dangerous to both operator and others in the vicinity unless established safe exposure procedures are strictly observed.
The useful and scattered beams can produce serious or fatal bodily injuries to any persons in the surrounding area if used by an unskilled operator. Adequate precautions must always be taken to avoid exposure to the useful beam, as well as to leakage radiation from within the source housing or to scattered radiation resulting from the passage of radiation through matter.
Those authorized to operate, participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the current established safe exposure factors and procedures described in publications, such as: Subchapter J of Title 21 of the Code of Federal Regulations, "Diagnostic X-ray Systems and Their Major Components", and the national council on radiation protection (NCRP) no. 102, "Medical X-ray And Gamma-ray Protection For Energies Up To 10 Mev-equipment Design and Use", as revised or replaced in the future.
Those responsible for planning of x-ray and gamma-ray equipment installations must be thoroughly familiar and comply completely with NCRP no. 49, "Structural Shielding Design and Evaluation For Medical Of X-rays and Gamma-rays of Energies Up to 10 Mev", as revised and replaced in the future. Failure to observe these warnings may cause serious or fatal bodily injuries to the operator or those in the area.
Add additional safety information as needed

Only qualified and system trained Philips service staff is allowed to perform service (installation, maintenance, quality assurance) on the Mx8000 IDT Family systems. Make sure that the latest version of the service instructions are available. Read the corresponding instructions carefully prior to working on the system. For your own safety and for more detailed safety information, refer only to the current version of the documents.
Use only specified tools and auxiliary materials. After finishing any service activity, ensure that all covers of the Mx8000, including the mylar gasket, are closed

Precautionary Measures Regarding Electrical Voltage

Before you start the procedure outlined in this manual, make sure that you read and understand the warnings listed below.

WARNING **PRIOR TO ANY SERVICE AND MAINTENANCE ACTIVITIES INSIDE COMPONENTS: SWITCH OFF THE SYSTEM AT THE MAIN POWER SUPPLY, (USING THE ON-SITE ON-OFF SWITCH) AND THE INTERNAL/EXTERNAL UNINTERRUPTIBLE POWER SUPPLY (UPS). MAKE SURE THAT NO OTHER PERSON CAN SWITCH ON POWER OR SWITCH OFF THE SECURITY MEASURES, WHEN INSTALLATION, MAINTENANCE OR SERVICE WORK ON THE SYSTEM IS PERFORMED.**

WARNING **WHEN PERFORMING ANY PROCEDURE INSIDE THE PDC:**
SWITCH OFF ALL EXTERNAL POWER, E.G. POWER FOR X-RAY WARNING LAMP.
PRIOR TO ANY INTERVENTION IN THE PDC, ALLOW AT LEAST FIVE MINUTES DISCHARGE TIME AFTER THE LAST SCAN. HAZARDOUS VOLTAGE LEVELS (>500V) MAY BE PRESENT EVEN IF THE SYSTEM IS SWITCHED OFF.

WARNING **IN ADDITION TO THE WARNINGS LISTED ABOVE, MAKE SURE TO FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN CHAPTER 1 OF THE MX8000 IDT FAMILY SERVICE MANUAL. FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.**

CAUTION **Always use an ESD protection wrist strap when servicing any component in the system.**

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1. General Scanner Data

The 0.5 sec. rotation time and 2x0.5mm slice thickness are optional, but must be calibrated and tested during integration.

Scanner S/N_____ DMS S/N_____

System Software Version_____

Fill in the following table before activating the X-ray:

XRT MODEL #	XRT REV. #	XRT SERIAL #	DATE INSTALLED	INITIAL SEC	FINAL SEC	POWER SUPPLY #

If the XRT or the PS is replaced, describe the reason of replacement in the following table:

_____

_____

_____

XRT MODEL #	XRT REV. #	XRT SERIAL #	DATE INSTALLED	INITIAL SEC	FINAL SEC	POWER SUPPLY #

The system was shipped with XRT serial tube #_____

The tube made _____ seconds during integration and factory testing.

Date _____ **Name** _____ **Signature** _____

2. A-Collimator Z-Direction Calibration

1. From the **Service** menu, click **XRT Z-Alignment**. Select **Calibrate** to bring the A-collimator to its optimal position relative to the focal position and to the P-Collimator.
2. From the **Service** menu, click **XRT Z-alignment**. Select **Hardware Z Check** to check the alignment accuracy and functioning of the PSD sensor responsible for Z-control and related hardware.

NOTE:

- The program also checks the parallelism of the A-plane relative to the P-plane and prompts if there is an error.
- The “TAB” table is updated if the calibration has finished successfully. The old table remains if an error was detected during calibration.
- There is no need to switch off the Gantry or to logout.

Check ✔ if CALIBRATION is OK	

In case of troubleshooting, check the difference between RAW of slice A and D at slice width 4x1 mm, RT 0.75 sec scanned in air. The allowed difference is less than ±10%.

Date _____ **Name** _____ **Signature** _____

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3. XRT Current Calibration

1. Install and center Head System Phantom on water layer and zero IN-OUT bed position.
2. Perform Air Calibration for STD res., 4x5, 120 kV, 0.75 sec.
3. From the **Calibration** menu, select **XRT Current Calibration**. Select **Calibrate** to calibrate the tube emission current, and follow the instructions.
4. Check the images. If they contain phantom parts other than water: move the phantom in the Z-direction; zero IN-OUT bed position again; and repeat the calibration.
5. Note the final calibration in the table below.
6. Reboot the system (log off and log on) to apply the new calibration factor.

NOTE:

The program performs Air Calibration and two scans to measure the X-ray noise on subtracted images. If the noise is beyond tolerance, the tube current is corrected and scans automatically repeated to verify.

	MEASURED FACTOR	ALLOWED FACTOR LIMITS	
FINAL CALIBRATION FACTOR		0.90	1.08

Date _____ **Name** _____ **Signature** _____

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4. DFS and Axis Calibration

1. Perform Air calibration with the following parameters:
   - STD and High Resolution
   - SW 4x5 mm
   - All kV
   - All rotation times
2. Install the System aluminum pin approximately 5 cm off-center (e.g. down).
3. From the **Service** menu, click **XRT-DFS Calibration**. Click **Select All** and select **Calibrate all Rot. Times**. Follow the on-screen instructions).
   The calibration takes about 0 minutes and is completely automatic.
4. Check OK if the calibration process ends successfully.

Check ✔ if CALIBRATION is OK	

NOTE:

The program calibrates the focal spot position in the X-direction for both FS1 and FS2 locations (Axis 1 and Axis 2). Calibration is performed in 3 stages:

1. Delay (phase) calibration (to synchronize the focal spot toggling for optimal Amplitude-Spacing calibration)
2. Offset calibration (to shift the average Axis position)
3. Amplitude calibration (to adjust the Spacing = distance between the Axis)

Date _____ **Name** _____ **Signature** _____

If the program reports a problem, exit the calibration and proceed to **XRT-DFS Calibration Diagnostics**.

1. Perform a scan with the “problematic” parameters and check the Axis and Spacing values. Repeat the scan a few times and see if the values are stable.
2. Perform a second test and change the Amplitude and/or Offset. If the values are not stable or if they are stable but the Axis and/or Spacing does not change, there is hardware problem.

The nominal Axes and spacing values are shown in the table below (for reference).

RESOLUTION	AXIS 1	AXIS 2	SPACING
Standard, High, Ultra-high	337.375	337.875	0.50
Ultra-fast	337.75		0.0

The tolerances are defined in the automatic program and may change with software version.

Date _____ **Name** _____ **Signature** _____

5. Fine Adjustment of the Ultra-High Collimator in the X-Direction

> **NOTE:**
>
> The U-High collimator mechanical adjustment is accurate if the High Resolution Axis Calibration performed previously was accurate.

1. Install the axis pin and reset the table display.
2. From the **Service** menu, click **XRT-DFS Alignment**. Click **UHR** and follow the instructions.
   The program automatically performs Air Calibration, scans the pins, displays the Axes value, and indicates the necessary U-High Resolution collimator movement.
3. Use the micrometer installed on the collimator to adjust the collimator in the X direction relative to the detectors.
   See *Appendix A "U-High Resolution Collimator (UHR) Adjustment Instruction"* for instructions on moving the collimator.
4. Enter the final result in the following table:

PARAMETERS	ALLOWED AXIS (DET)	FINAL AXIS (DET)
Average Axis	337.610–337.640	
Spacing	0.480–0.520	

5. Note the shift made (including the sign) in the following table.

THE UHR COLLIMATOR WAS SHIFTED BY ±0.XX MM

Date _____ **Name** _____ **Signature** _____

6. Marker Alignment Test

6.1 Slice Markers Alignment

1. Perform Air calibration according to the protocol below.
2. Install the “Marker-Initial Zero” phantom approximately in the center of the scan circle.
3. Perform a Lateral Surview Scan at 90^0 and plan a study to correct the Gantry Tilt. Repeat the Surview Scan at 180^0 and correct the phantom Swivel.
4. Perform an Axial scan with the following parameters:

HEAD PROTOCOL	
FOV: 250 mm	Filter: EB
Slice Thickness: 1 mm (Fused 2x0.5)	Matrix: 512 × 512
Scan Time: 0.75 sec	Zoom: 1
120 kV, 50 mAs	STD Resolution

All the wires should be visible on the first image.

1. Without moving the phantom, adjust the light markers on the rotor to fall onto the wires.
2. Move the MAX UP and MAX DOWN. The lights should not shift by more than ± 2 mm while in movement.
3. Rotate the rotor. The lights should form a non-split line and shift less than ± 1 mm during the full rotation.
   If one of the light markers does not comply with the tests above, replace it.

The allowed misalignment of the light markers is: ± 1 mm for slice markers.

4. Repeat steps 1 to 3 while setting the the stator light markers on the phantom on stator light markers.

Date _____ **Name** _____ **Signature** _____

6.2 Symmetry Markers Alignment

1. Use the image previously made and the grid to check that the phantom is approximately centered.
   a. Adjust the wires to the 3, 12, and 9 o'clock positions on the image.
   b. Move the phantom UP or DOWN and adjust the wires if necessary.
   c. Move the bed out so that the Axial light markers shine on the phantom.
2. Align each symmetry marker to fall onto the respective wire. Move the phantom back in and recheck the alignment.

The allowed misalignment of the markers is: ± 2 mm for symmetry markers.

Check ✔ if adjusted within tolerances	

Date _____ **Name** _____ **Signature** _____

7. Impulse Response Measurement

1. Perform Air Calibration according to the protocol below.
2. Install the Physics System phantom. Adjust it **in the center** of the Gantry.
3. Perform a Lateral Surview scan and plan an Axial slice in the middle of the 2 plastic rectangles for slice width measurement to adjust Tilt so that the phantom axis is perpendicular to the rotation plane.
4. Type in the protocol name: **phys_Impulse_head.proc** in the protocol window of the Patient Data.
5. Perform a scan with the following parameters:

> **NOTE:**
>
> This protocol forces the Image Balance to NO and disregards the flag in Service Parameters and reduces the CT number approximately in half.

IMPULSE RESPONSE PROTOCOL	
FOV: See *Table 1*	Filter: See *Table 1*
Slice Thickness: 4x1 mm	Matrix: 1024 x 1024 (or 512 x 512 if 1024 is not available)
Scan Time: 2 sec	Center X [mm] = 0
Resolution: See *Table 1*	Center Y [mm] = 0
120 kV, 600 mAs	Phantom Calibration=No
	Image Balance=No

Date _____ **Name** _____ **Signature** _____

6. From the **Misc** menu, click **Impulse Response**.
7. Retrieve the last images from the Archive. Click **Cursor** on the left graphic bar and adjust (move) the cursor approximately on the wire.
8. From the **Misc** menu, click **Impulse Response**. Click **Distance Measurement** and note the measured coordinates X,Y (rounded to integer). Minimize the **Impulse Response** viewer.
9. Click * to bring the current protocol on the left and enter the measured **X, Y** coordinates in the **Recon** window. Change the FOV to 25 mm (zoom=10) and repeat the scan.
10. Open the IR viewer and load the last images. Click **Cursor** on the left and adjust (move) the cursor approximately on the wire.
11. Click **Calculate** to activate the **Impulse Response** measurement.
12. Enter the results of Impulse Response in *Table 1*.

Table 1:

FILTER	FOV (mm)	RESOLUTION	DESIRED I.R (mm)	MEASURED I.R. AT 50% (mm)	
				SLICE A	SLICE C
EB	50	Standard	1.37±0.10		
E	25	High	0.64±0.05		
E	25	Ultra-High	0.47±0.06		

Date _____ **Name** _____ **Signature** _____

8. Slice Width Measurement

Perform Air Calibration according to the protocol below.

1. Install the System phantom for Slice Width measurement.
2. Perform a Lateral Surview scan and plan an Axial slice in the middle of the four rectangles located in the Phantom at the 12, 3, 6, and 9 o'clock position to adjust Tilt so that the phantom axis is perpendicular to the rotation plane.
   The CT number of the rectangles should be (130±20) CT at 2.5 slice thickness. Adjust the Phantom IN or OUT for better precision.
3. Perform Axial scans with the following parameters:

HEAD PROTOCOL	
FOV: 150 mm	
Slice Thickness: See *Table 2*	Filter: See *Table 2*
Scan Time: 1 sec	Matrix: 512 × 512
Resolution: See *Table 2*	Phantom Calibration=No
120 kV, 300 mAs	Image Balance=No

4. Run the **Slice Width** measurement program from **Misc|Slice Width.** Click **Open Archive**, select one image for measurement, and click **OK**. Click **Vertical ROI** on the left tool bar.
5. Move and rotate the ROI to position it symmetrically on the aluminum strip and parallel to the plastic rectangles. Click **Plot** when ready, to view the sensitivity profile and the measurement result.
6. Measure both vertical aluminum strips, average the results, and enter them to the following table.

Date _____ **Name** _____ **Signature** _____

NOTE:

The discrepancy for the small slice widths between the measured and nominal values is due to the finite scanner resolution and the measurement method and the phantom.
For example, the smallest Slice Thickness 0.9 infers the actual value of 0.5 mm.

Table 2:

RESOL./ FILTER	NOMINAL SW	MEASURED SLICE THICKNESS	SLICE A AVG (MM)	SLICE B AVG (MM)	SLICE C AVG (MM)	SLICE D AVG (MM)
UHR E	2x0.5	0.90±0.20			N/A	N/A
UHR E	4x1	1.15±0.20				
UHR E	4x2.5	2.5±0.25				
High D	4x5	5.0±0.30				
High D	2x8	8.0±0.40			N/A	N/A

Date _____ **Name** _____ **Signature** _____

9. Phantom Calibration

1. From **Service**, activate **Show Temperature** and note the DMS temperature. Check if the temperature is stable within ±1°× for the last ten minutes.
2. Set the Gantry tilt to zero.
3. Install the Head Calibration Phantom. Use the laser light marker to position it initially on a special white groove.
4. Reset the bed position to zero at this location.
5. Move the bed to MAX down, approximately 3–5 mm from the covers.
6. From the **Service** menu**,** click **Phantom Calibration**. Click **Head**, select **90** and **120** kV, all Slice Width modes with Air Calibration. Click **Head Scan**. Follow the on-screen instructions.
7. Repeat the same for the Body Calibration Phantom. Click **Body**, select **All voltages**, all Slice Width modes with Air Calibration. Click **Body Scan**. Follow the on-screen instructions.

WARNING

THE GANTRY WILL ROTATE FOR TWO MINUTES BEFORE AND BETWEEN THE CALIBRATION MODES FOR TEMPERATURE STABILIZATION

8. Back-up the calibrations on the EOD disk.

Check ✔ if **HEAD CALIBRATION** is **OK**	
Check ✔ if **BODY CALIBRATION** is **OK**	

Date _____ **Name** _____ **Signature** _____

10. Image Noise (SD) Check

1. Perform Air Calibration according to the following table.
2. Scan twice for each mode in the next table using both Phantom calibration and Image Balance. Use the system phantom and scan the water layer for Head and the aculon layer for Body.
3. Place a 7,000±500 mm² area ROI at the center of the resulting Head images and a 14,0000±500 mm² area ROI on the Body images. Enter the STD average value corresponding to two scans into the following table. Use the single images window, maximum size for this measurement.
4. Check the image flatness by using a 1,000±200 mm² area ROI in the center and a sliding 700±100 mm² area ROI to be moved around but not closer than 1 cm from the “bone”.

The maximum allowed difference between CT value measurements of this ROI is 4 CT units.

Use the following scan parameters:

HEAD PROTOCOL	
FOV: 250 mm	Filter: EB
Slice Thickness: See *Table 3*	Matrix: 512 × 512
Scan Time: 0.75 sec	Phantom Calibration-Yes
120 kV, 250 mAs	Image Balance-Yes

BODY PROTOCOL	
FOV: 350 mm	Filter: B
Slice Thickness: See *Table 3*	Matrix: 512 × 512
Scan Time: 0.75 sec	Phantom Calibration-Yes
140 kV, 300 mAs	Image Balance-Yes

Date _____ **Name** _____ **Signature** _____

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Table 3: Standard Deviation (SD) Measurement Table

SCAN PARAMETERS			MEASURED SD $\times 10^3$				ALLOWED SD X 10^3	
H/B	kV	SW	A	B	C	D	MINIMUM	MAXIMUM
Head	120	8			N/A	N/A	3.3	4.0
Head	120	5					4.2	4.9
Head	120	2.5					5.9	7.1
Head	120	1					9.3	11.5
Head	120	0.5			N/A	N/A	13.8	17.3
Body	140	5					9.0	11.0

Date _____ **Name** _____ **Signature** _____

11. HCOR Calibration

1. Perform Air Calibration for all relevant modes.
2. Scan the Physics System Phantoms—water for Head, and Aculon for Body with the following protocols:

HEAD PROTOCOL	
FOV: 250 mm	Filter: EB
Slice Thickness: 4x5	Matrix: 512 × 512
Scan Time: 0.75 sec	Zoom: 1
90 kV and 120 kV, 250 mAs	Phantom Calibration-Yes
	Image Balance-Yes

BODY PROTOCOL	
FOV: 350 mm	Filter: B
Slice Thickness: 4x5	Matrix: 512 × 512
Scan Time: 0.75 sec	Zoom: 1
90 kV, 120 kV, and 140kV, 300 mAs	Phantom Calibration-Yes
	Image Balance-Yes

3. Place a large ROI on the middle of the image for each slice of the Head phantom and a small ROI on the water insert of the Body phantom images. Measure the CT number and average all slices.
4. From the **Service** menu, click **HCOR**. Adjust the average to: **0 ±2 CT numbers**.
5. Go through all the modes in *Table 4* and make necessary corrections to the scale factors.

If the Measured Factor differs more than allowed (±1.5%) from the default, check the kV or look for possible wrong filtration: brass filter, wedge, etc.

Date _____ **Name** _____ **Signature** _____

Table 4: CT Correction Factors for Slice B, Adult, SW 5

MODE (SLICE B, SW 5 MM)	CURRENT FACTOR	DEFAULT FACTOR	DIFFERENCE FROM DEFAULT (%)	DESIRED CT
HEAD				
Low kV (90kv)		0.980		0
Medium kV (120kV)		1.050		0
BODY				
Low kV (90kv)		1.000		0
Medium kV (120kV)		1.090		0
High kV (140kV)		1.133		0

Date _____ **Name** _____ **Signature** _____

12. Image Quality Check

WARNING

CLOSE ALL GANTRY COVERS BEFORE PERFORMING TESTS.

CHECK THAT THE TEMPERATURE REGULATION OF THE GANTRY AND THE DMS FUNCTIONS PROPERLY. WAIT FOR THE TEMPERATURE TO STABILIZE TO WITHIN ±2°C.

1. Perform Air Calibration, all modes.
2. From the **Service** menu, click **Service Parameters**. Switch to **Phantom Calibration = Yes**, **Image Balance= Yes**.
3. Use the Physics System phantom and perform at least 2 scans for each mode according to the tables below.

Use the scan parameters according to the following tables.

4. Set the window width to 100 CT. Look for possible rings or other artifacts according to the next table. Enter their CT values in the appropriate places in the table below
5. Check the image fllatness in row 2 in the following table by using a 1,000±200 mm² area ROI in the center and a sliding 700±100 mm² area ROI to be moved around, but not closer than, 1 cm from the “bone” or phantom edge.

ALLOWED VALUES:

- No rings or bands are allowed on the images
- Flatness tolerance: X ± 2 CT as measured on centered phantom and X ± 4 CT on off-center phantom.

NOTE:

Image flatness = CT number uniformity

Date _____ **Name** _____ **Signature** _____

Table 5: Head Protocol, FOV 250 mm, 512 matrix, 20 mm UP

PHANTOM	SCAN PARAMETERS KILOVOLT, SW, RESOLUTION, ROT. TIME, mAs, FILTER	CT SLICE A	CT SLICE B	CT SLICE C	CT SLICE D	ALLOWED CT NO.
Head pins	120kV, 4×2.5, High, 0.75s, 245 mAs, C					±4
Head pins	120kV, 4x5, STD, 0.75s, 250 mAs, B, **with Ultra Image**					±4
Head water	120kV, 2x8, STD, 0.75s, 250 mAs, EB			N/A	N/A	±4
Head water	120kV, 4x5, STD, 0.75s, 250 mAs, EB					±4
Head water	120kV, 4x2.5, STD, 0.75s, 250 mAs, EB					±4
Head water	120kV, 4x1, STD, 0.75s, 300 mAs, C					±6
Head water	120kV, 2x0.5, STD, 1.5s, 350 mAs, EB			N/A	N/A	±10
Head water	120kV, 4x2.5, U-high, 1.0s, 300 mAs, B					±6
Head pins	120kV, 4x1, U-high, 1.0s, 300 mAs, C					±6
Head pins	120kV, 2x0.5, U-high, 1.5s, 300 mAs, C			N/A	N/A	±10
Head water	120 kV, 4×5, Ultra-fast, 0.5s, 250 mAs, EB					±4

Date _____ **Name** _____ **Signature** _____

Table 6: Body Protocol, FOV 350 mm, 512 matrix, 30 mm UP

PHANTOM	SCAN PARAMETERS KILOVOLT, SW, RESOLUTION, ROT. TIME, mAs, FILTER	CT SLICE A	CT SLICE B	CT SLICE C	CT SLICE D	ALLOWED CT NO.
Body	120kV, 2x8, STD, 0.75s, 300 mAs, B			N/A	N/A	±4
Body	120kV, 4x5, STD, 0.75s, 300 mAs, B					±4
Body	120kV, 4×2.5, STD, 1.0s, 300 mAs, B					±4
Body	140kV, 4x5, STD, 1.5s, 300 mAs, B					±4
Body	120kV, 4x5, STD, 2.0s, 300 mAs, B					±4
Body	120kV, 4x5, STD, 0.5s, 250 mAs, B					±4
Body	90kV, 4x1, STD, 1.0s, 250 mAs, B					±6
Body	140kV, 4x2.5, High, 1.0s, 250 mAs, B					±4
Body	120 kV, 4x1, STD, 0.75s, 100 mAs, B					±6
Body	140kV, 4x2.5, U-High, 1.5s, 400 mAs, B (FOV=250 mm)					±10
Body	120kV, 4x5, STD, 0.75s, 200 mAs, B FOV=500mm, Phantom MAX Down					N/A
SURVIEW SCAN, 500 MM LENGTH						
Body	120kV, 30 mA, Scan angle 180°, Weight factor D (Check if OK)					N/A

Date _____ **Name** _____ **Signature** _____

13. System Phantom Calibration and Check

The following tests are done on the System Phantom supplied with the scanner aligned in the center. Make sure that the Water CT density is zero on both Head and Body sections.

Scan according to the following protocols:

HEAD PROTOCOL	
FOV: 250 mm	Filter: EB
Slice Thickness: 4x5	Matrix: 512 × 512
Scan Time: 0.75 sec	Zoom: 1
120 kV, 250 mAs	Phantom Calibration-Yes
	Image Balance-Yes

BODY PROTOCOL	
FOV: 350 mm	Filter: B
Slice Thickness: 4x5	Matrix: 512 × 512
Scan Time: 0.75 sec	Zoom: 1
120 kV or 140kV, 300 mAs	Phantom Calibration-Yes
	Image Balance-Yes

Use slice B and measure the CT numbers of the pins and of the phantom material. Fill in the Phantom Label and the following table. Note both the 120 kV and 140 kV measurement values for the Body entry on the label. See *Figure 1* for pins on the system phantom.

> **NOTE:**
>
> There are fluctuations in the CT numbers between different batches of the same plastic material. Therefore, the tolerance here is larger than specified in the Operation Manual. The numbers measured in the field (according to the manual) are compared with the correct values defined in this test and noted on the Phantom Label.

Date _____ **Name** _____ **Signature** _____

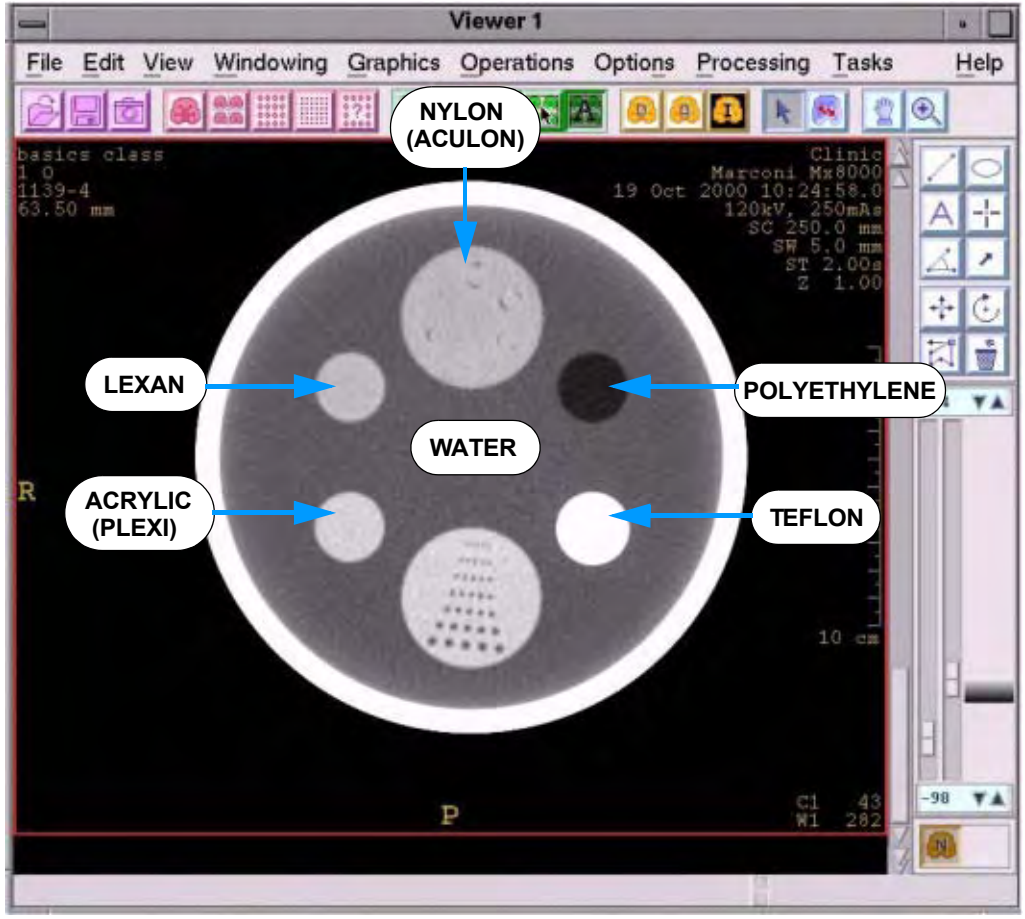

Figure 1: System Phantom

Date _____ **Name** _____ **Signature** _____

PIN MATERIAL	DESIRED	HEAD	BODY
Water	0±4		
Polyethylene	-75±10		N/A
Nylon (Aculon)			
Head 120 kV	100±15		N/A
Body 140 kV	100±15	N/A	
Body 120 kV	100±15	N/A	
Lexan	116±15		N/A
Acrylic (Plexi)	140±15		N/A

Teflon			
Head 120 kV	1016±50		N/A
Body 140 kV	870±50	N/A	
Body 120 kV	890±50	N/A	

Date _____ **Name** _____ **Signature** _____

Appendix A
U-High Resolution Collimator (UHR) Adjustment Instruction

> **CAUTION**
> THE UHR MECHANISM IS VERY SENSITIVE. FOLLOW THE INSTRUCTIONS CAREFULLY.

A.1 Ultra-High Resolution Calibration

1. Install the axis pin 5 cm off center in the down direction—couch height (v=140).
2. Reset the in/out display to ZERO.

> **NOTE:**
> Not resetting the in/out display to zero will cause inaccurate output.

3. From the **Service** menu, click **XRT-Alignment**. You are requested to click enable twice.
   The program displays the measurements results, and recommends the required collimator movement (in mm) and the direction (clockwise or counter-clockwise). *Figure 2* shows an example of the measurement results as seen on the screen.

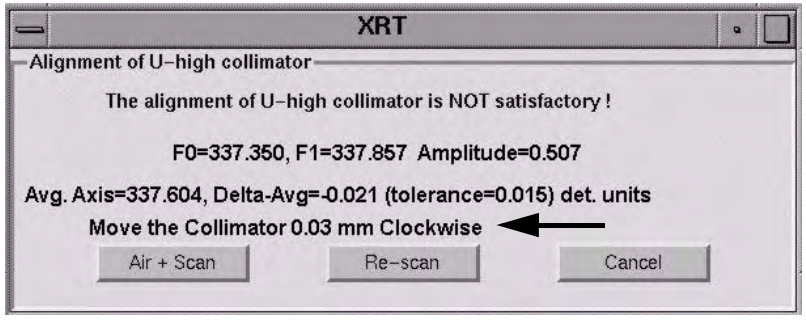

Figure 2: UHR Collimator Measurement Results

4. Write down the information regarding collimator movement (note the line in *Figure 2* "Move Collimator 0.04 mm Clockwise").

WARNING

THE FOLLOWING ADJUSTMENT PROCEDURE IS DONE WHILE THE GANTRY FRONT COVER IS OPEN. FOLLOW THE INSTRUCTIONS EXACTLY STEP-BY-STEP AND COMPLY WITH ALL SAFETY PRECAUTIONS FOR YOUR OWN SAFETY.

5. Move the bed to the maximum out and maximum down position.
6. Remove the pin holder from the bed.
7. Press the stop button on the Gantry. It is important for the adjustment procedure that the system stay in the **stop** stage (it releases the UHR collimator from its locked position).
8. Open the front Gantry cover carefully while observing the mylar gasket. Remove the gasket and place it aside.
9. Turn the Service Switch S301 OFF (to **0** position).
10. Manually rotate the Gantry rotor in the clockwise direction and bring the DMS to a 12 o'clock position.
    Lock the rotor with the locking pin.
11. Proceed to *"Mechanical Adjustment Procedure"*.

Figure 3: Gantry at 12 o'clock

Mechanical Adjustment Procedure

CAUTION

THE UHR MECHANISM IS VERY SENSITIVE. FOLLOW THE INSTRUCTIONS CAREFULLY.

1. Read the UHR *x* position with the micrometer as follows (see *Figure 4*):
   a. Bring micrometer face to UHR base. Do **not** apply excessive force.

NOTE:

One complete turn of the thumb wheel equals 0.5 mm. Each division on the thumb wheel equals an increment of 0.01 mm.

   b. Repeat the reading operation three times, to make sure you are reading the same measurement. Note the measurement.
2. Loosen the four M5 screws ().
3. Push the UHR base left to the micrometer face. Make sure there is no gap between them.
4. While pushing gently the UHR base to the micrometer face, tighten the M5 screws with an initial moment of 10 Nm.
5. Repeat with a final moment of 20 Nm.

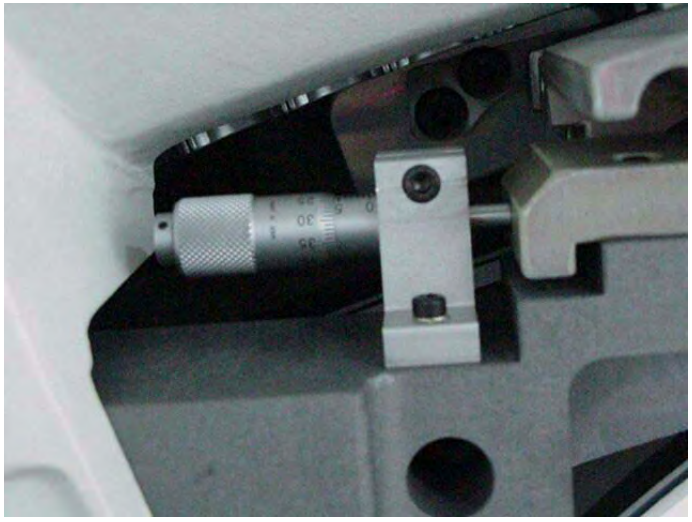

Figure 4: UHR Micrometer

Appendix B
Default System Parameters

From the **Service** menu, click **Service Parameters** to view the default system parameters are as follows:

Table 7: Reconstruction Parameters

Phantom Calibration	Yes
Image Balance	Yes
Slice Normalization	Yes
RAW Mode	PREP
Image Threshold	100

Table 8: Scan Parameters

Scan with X-ray	Yes
CDRH test	No
Gantry Rotation	Yes
Diagnostic level	0
XRT warm-up	30%
Z-control	Yes